Διαγράμματα Feynman και υπολογισμοί Møller

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$$M = \int (2\pi)^4 \delta(p_1 + p_2 - q)(-ig)(2\pi)^4 \delta(q - p_3 - p_4) \frac{d_q^4}{(2\pi)^4}$$

$$M = \frac{-ig^2}{(p_3 + p_4)^2 - m_{B^2}}$$

$$M = \int (2\pi)^4 \delta(p_1 + p_2 - q)(-igw) \frac{i}{q^2 - m_{W^2}} (-igw)(2\pi)^4 \delta(q - p_3 - p_4) \frac{d_q^4}{(2\pi)^4}$$

$$M = \frac{-ig_w^2 (2\pi)^4 \delta(p_1 - p_2 - p_3 - p_4)}{(p_3 + p_4)^2 - m_{w^2}}$$

Feynman

$spin - 0$ boson $\frac{i}{q^2 - m^2}$

$spin - \frac{1}{2}$ $\quad i\frac{\not{q} + m}{q^2 - m^2} = \frac{i}{\not{q} - m}$ $\quad \not{q} = \gamma^\mu q_\mu$

photon $\frac{i}{k^2}\left(-g^{\mu\nu} + (1 - \zeta)\frac{k^\mu k^\nu}{k^2}\right) = \frac{-i}{k^2} g^{\mu\nu}$

(ζ=1) Feynman

$$M_1 = -g_e^2 \bar{u}(p_3, s_3)\gamma^\mu u(p_1, s_1)\left(\frac{g_{\mu\nu}}{(p_1 - p_3)^2}\right)\bar{u}(p_4, s_4)\gamma^\mu u(p_2, s_2)$$

$$M_2 = g_e^2 \bar{u}(p_4, s_4)\gamma^\mu u(p_1, s_1)\left(\frac{g_{\mu\nu}}{(p_1 - p_4)^2}\right)\bar{u}(p_3, s_3) u(p_2, s_2)$$

$M_{\text{Moller}} = M_1 + M_2$

$\bar{u}(p_4, s_4)\gamma^0 u(p_2, s_2) = 0$

$\bar{u}(p_3, s_3)\gamma^0 u(p_1, s_1) = 0$

$\bar{u}(p_4, s_4)\gamma^1 u(p_2, s_2) = 2p$

$\bar{u}(p_3, s_3)\gamma^1 u(p_1, s_1) = 2p$

$\bar{u}(p_4, s_4)\gamma^2 u(p_2, s_2) = -2ip$

$\bar{u}(p_3, s_3)\gamma^2 u(p_1, s_1) = -2ip$

$\bar{u}(p_4, s_4)\gamma^3 u(p_2, s_2) = 0$

$\bar{u}(p_3, s_3)\gamma^3 u(p_1, s_1) = 0$

$g_{\mu\nu}\bar{u}(p_4, s_4)\gamma^\mu u(p_2, s_2) = 2p(1-i)$

$\bar{u}(p_3, s_3)\gamma^\mu u(p_1, s_1) = 2p(1+i)$

$M_1 = -g_e^2 \frac{8p^2}{(p_1-p_3)^2}$, $E^2 = m^2 + p^2 \Rightarrow \quad (p_1 - p_3)^2 = -4p^2$

$M_1 = 2g_e^2$